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Observation of Forbush Decrease using YBJ-ARGO-spt

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The YBJ-ARGO experiment is located in Tibet at 4300m a.s.l.. The search for ground level enhancement at E>10GeV can be done with the single particle technique of this experiment, which consists in recording the counting rat of the detector. Moreover the same data can be used to search for gamma-ray burst and check the detector stability. In this paper an analysis of the single particle rates collected in Jan. 2005 for observation of GLE and Forbush decrease is presented.

1. Introduction

The Forbush decrease (FD) is the observed decrease in cosmic ray activity in the Earth's atmosphere about a day after a solar flare, it is believed to be caused by a shielding effect of the magnetic fields contained in the plasma cloud emitted from the sun at the time of the flare. For charged particles the observed phenomenon is the ground level enhancement (GLE), associated with solar flares with large coronal mass ejection. The observation of FDs and particles in GLE can improve our knowledge of the solar activity and the acceleration processes during solar flares. The FDs and GLE could be observed with the single particle technique (SPT) besides the neutron monitors (NMs) on the surface of the Earth. After major solar activity in January 2005 many neutron monitors in the world recorded several pronounced variations in the ground-level cosmic ray intensity. For example, the IGY neutron monitor at Jungfraujoch (Rc = 4.5 GV), first observed a Forbush decrease with onset around noon GMT on January 17, 2005, and with maximum amplitude of about -15%. The FD was associated with enhanced geomagnetic activity. On January 20, with onset at 06:54 UT, i.e. still during the main phase of the FD, a solar cosmic ray ground level enhancement was observed. This GLE reached the maximum amplitude of 11.4% in the 1-minute recordings. The YBJ-ARGO experiment is located in Tibet at 4300m a.s.l.. The observation of FD (Rc = 14.1 GV) and search for ground level enhancement at E>10GeV can be done with the single particle technique of this experiment, which consists in recording the counting rat of the detector. In the following we do the study of FD and GLE in January 2005 with YBJ-ARGO-spt data.

2. The YBJ-ARGO-spt

The YBJ-ARGO experiment is a "full coverage" air shower detector located at Yangbajing (30.11N, 90.53E, 4300m a.s.l.,606g/cm^2)[1]. It consists of a 74*78m^2 central carpet of a single layer of Resistive Plate Chambers (RPCs). The detector has a modular structure, the basic element being a "cluster" of 12 RPCs with one RPC consists of 10 the smallest detector units so-called PADs (each with 8 readout strips). In January 2005,16 clusters are connected to the DAQ and getting SPT data. The SPT signals are available for each cluster, giving the multiplicity of at least 1 particle ($n \geqq 1$) to at least 4 particles ($n \geqq 4$) detected on the whole cluster surface. Single particle rates have been collected with a gating time of 500 ms[2].

3. Meteorological effects

In studying of cosmic ray variations with SPT data, for reception of quantitative results is necessary to correct data on meteorological effects. Barometric and temperature factors of regression can be received directly from experimental data. Atmospheric pressure (accuracy 0.1 mb) in Yangbajing is measured once 1 second and 20 minutes. Therefore in the analysis the data of counting rate per second were used. The data of a temperature of atmosphere outside and inside the experiment hall are absent. Figure 1 shows the correlation between pressure and counting rate. Here the counting rate is the sum of 12 clusters which stability running in our interesting duration. It seems that multiplicity $n \geq 2,3,4$ have stable counting rate to pressure relationship while $n \geq 1$ have less. This may means that $n \geq 1$ will suffer more systematic uncertainty with other meteorological factors interaction. For multiplicity $n \geq 1,2,3,4$, the values of regress factors are -0.44±0.03, -0.90±0.03, -0.94±0.02, -0.95±0.02 (%/mb) respectively.

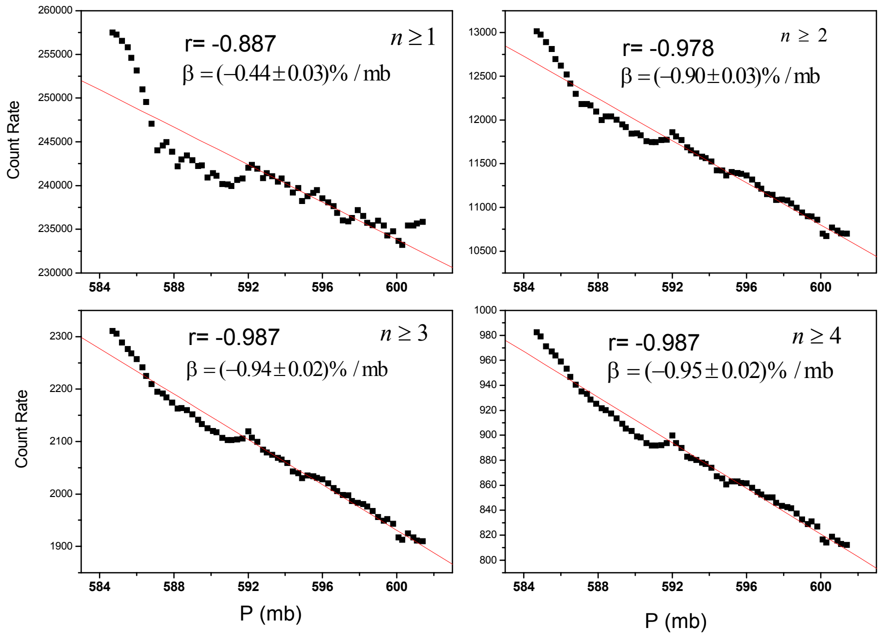

Figure 1. Atmospheric pressure versus SPT count rate for different multiplicity n. r is the Pearson's correlation between pressure and count rate.

4. FD and GLE

After making the correction on pressure, we analysis the SPT data from 15th to 27th of January, 2005. The result is shown in figure 2. The Forbush decrease around noon on January 17, 2005 is observed with YBJ-ARGO-spt multiplicity n≧1,2 data, while in n≧3,4 data have not been found. The maximum amplitudes of the FD are about -5% and -4% respectively. As comparing, the maximum amplitude of this FD is about -7% with NM in Yangbajing.

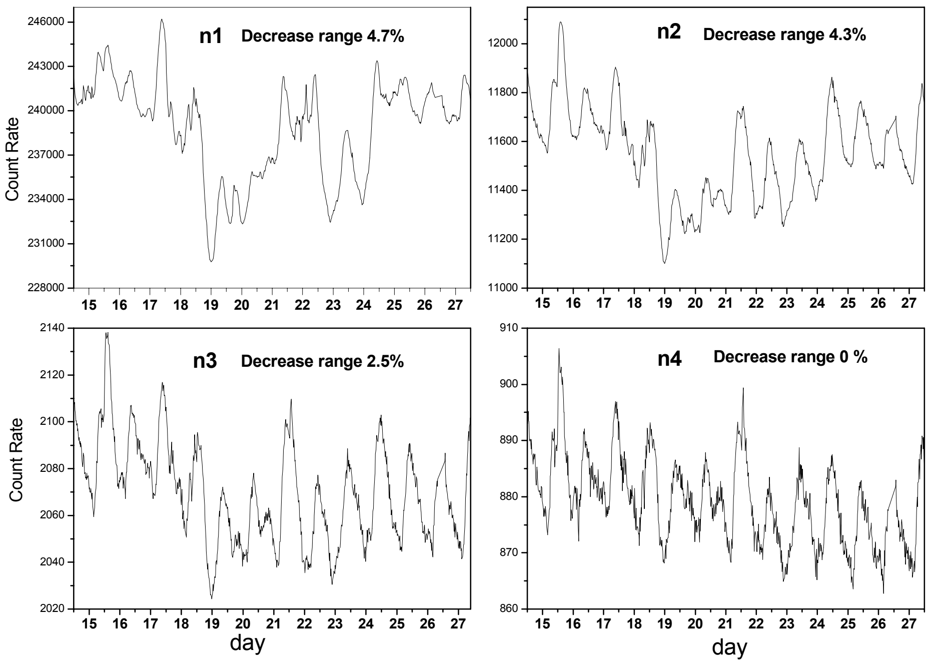

Figure 2. SPT Count rate distribution from 15th to 27th January, 2005 for 12 clusters of YBJ-ARGO.

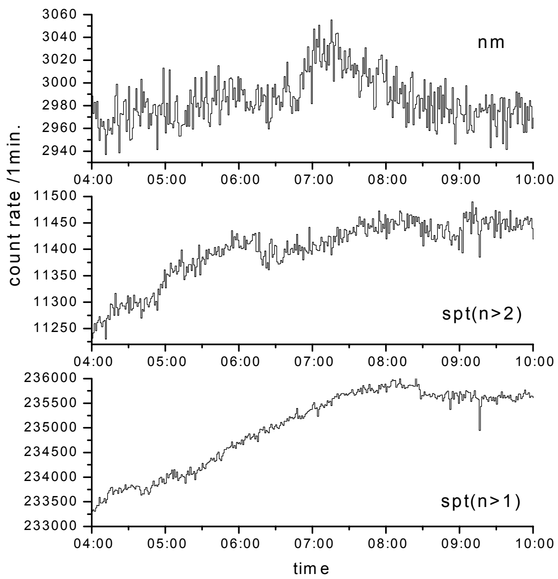

Figure 3. Count rates variation of NM in Yangbajing and YBJ-ARGO-spt during GLE on 20th January,2005.

We check the count rates of NM in Yangbajing and YBJ-ARGO-spt from 4:00 to 10:00UT on 20th January, 2005. The 1 minute count rates result is shown in fig.3. The NM gives the evidences of the GLE, but spt have not.

5. Conclusions

With the preliminary YBJ-ARGO-spt data in January 2005, we analysis the correlation between pressure and counting rate. The Forbush decrease on January 17,2005 is onset in the corrected data with multiplicity n >=1,2. The maximum amplitude of the FD accords with NM in Yangbajing. The YBJ-ARGO-spt have not seen the GLE on January 20,2005, maybe because of the influence of other meteorological parameters such as indoor and outdoor temperature or the higher threshold energy.

References

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